

CLAIMS

We claim:

1. A method of making a contoured muntin bar comprising:
 - a) providing a supply of sheet material having a finished surface on at least one side in the form of a coiled ribbon;
 - b) uncoiling the ribbon;
 - 5 c) feeding the ribbon to a punch station comprising a ribbon punching mechanism;
 - d) punching the ribbon at a precisely predetermined locations along the ribbon to form one of a plurality notch patterns that define a portion of a contoured muntin bar;
 - e) moving the ribbon downstream from the punch station through a forming station comprising a succession of forming rolls having a succession of forming roll nips to bend the ribbon and form a generally closed cross-sectional tube having a contoured shape with raised flat outwardly facing surfaces;
 - 10 f) delivering said closed cross-section tube from the forming station to a cutting station comprising a muntin bar severing apparatus; and
 - g) severing an endmost muntin bar at a precisely predetermined location by cutting the tube along a cut line defined by one of said notch patterns.
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2. The method of claim 1, further comprising the step of coordinating the severing of said muntin bar by the step of sensing arrival of one of the notch patterns in a side of the muntin tube by means of a sensor.
3. The method of claim 2, further comprising the step of programming a process controller to produce a batch of muntin bars which when interconnected form a single grid.
4. The method of claim 2, further comprising the step of programming a process controller to produce all required muntin bars of a first stock type before producing muntin bars of a second stock type.

5. The method of claim 1 additionally, in response to sensing a notch pattern for forming a mitred bar end, performing the step of clamping an end of the muntin tube prior to the severing step, and after the severing step, moving the severed muntin bar away from the muntin tube to widen a gap between said severed muntin bar and said muntin tube, and finishing mitred ends of the severed muntin bar and said muntin tube that are spaced apart by the gap.

6. The method of claim 5 wherein the finishing step is performed by inserting a abrasive tool into the region of the widened gap to contact said mitred ends.

7. The method of claim 6 wherein the abrasive tool is a router bit that is rotated as it is inserted into the gap to bring rotating surfaces of the router bit into contact with the mitred ends to perform the finishing step.

8. The method of claim 1 wherein the form rolls bend the strip into a tubular member having four outwardly facing planar surfaces wherein adjacent first and second planar surfaces are interconnected by two interconnecting beveled surfaces that form a v-shaped region between said first and second planar surfaces.

9. The method of claim 1, further comprising delivering the severed muntin bars to a post forming conveyer for moving the bars away from the forming station for subsequent assembly into a muntin bar grid.

10. The method of claim 1 wherein the punch step forms either a) a side notch for inserting a muntin bar grid connecting clip b) notches that form a mitred end to a muntin bar or c) registration notches for defining a severing point during the severing step.

11. Apparatus for making a contoured muntin bar comprising:

a) a supply of sheet material having a finished surface on at least one side in the form

of a coiled ribbon;

- 5 b) a driver for uncoiling the ribbon from the supply and feeding the ribbon through a succession of forming stations positioned along a travel path;
- c) a ribbon punch for punching the ribbon at a precisely predetermined location along the ribbon to one of a plurality of notch patterns that define a portion of a contoured muntin bar;
- d) a forming station comprising a succession of forming rolls having a succession of forming roll nips to bend the ribbon as said ribbon moves along the travel path and form an elongated,
10 generally closed cross-sectional tube having raised planar sections on opposite sides of said tube; and
- e) a cutting station comprising a muntin bar severing apparatus for severing an endmost muntin bar at a precisely predetermined location by cutting the tube along a cut line that intersects one of the multiple punch patterns.

12. The apparatus of claim 11 further comprising a process controller associated with said forming stations for sensing movement of the ribbon as said ribbon is unwound from the supply and producing control signals for activating the ribbon punch.

13. The apparatus of claim 12 further wherein said process controller includes instructions to produce a plurality of muntin bars constructed for assembly into a single grid.

14. The apparatus of claim 12 further wherein said process controller includes instructions to produce all required muntin bars of a first stock type before producing muntin bars from a second stock type.

15. The apparatus of claim 13 additionally comprising a clamp for clamping the tube prior to the severing and further comprising means for moving apart first and second muntin bars spaced by a gap caused by the severing step to widen the gap between ends of said first and second muntin bars, and said apparatus additionally comprising an abrasive tool for finishing ends of the first and second muntin bars facing the gap between the ends of the first and the second muntin bars.

16. The apparatus of claim 14 wherein the abrasive tool is a router bit that is rotated as it is inserted into the widened gap so that surfaces of the router bit perform the finishing step.

17. The apparatus of claim 15 further comprising apparatus including an end station comprising a conveyor that delivers the muntin bars from the severing station for subsequent assembly into a muntin bar grid.

18. The apparatus of claim 13 wherein the cutting station comprises a saw blade for cutting an endmost muntin bar from the tube.

19. The apparatus of claim 18 wherein the saw blade and router bit are mounted to a common support for movement into and out of a tube path of travel at the cutting station.

20. The apparatus of claim 19 comprising a linear actuator for moving the common support and wherein the process controller supplies control signals to the common support to co-ordinate severing and finishing of mitred ends of muntin bars at the cutting station.

21. The apparatus of claim 13 additionally comprising a sensor for monitoring movement of the punch patterns and sending sensor signals to the controller for initiating the severing of an endmost muntin bar.

22. An apparatus for making muntin bars comprising:

- a) an uncoiler for supporting coiled ribbon stock;
- b) a notching device for receiving ribbon stock from the uncoiler, the notching device having a number of individually activated punches to form different notch patterns along the length of the ribbon stock;
- c) a roll forming machine having a plurality of roll assemblies adapted to receive ribbon stock from the notching device and form in stages a hollow contoured muntin bar tube having at least two raised portions that extend along said tube; and
- d) a severing device for severing the muntin bar at predetermined locations to form

10 individual notched muntin bars.

23. The apparatus of claim 22 further comprising a sensor for sensing the length of ribbon stock delivered to the notching device, and a process controller associated with the notching device, roll forming machine, and severing device, wherein the sensor provides signals to the controller indicating the sensed ribbon length, and the process controller provides control signals for enabling operations of said notching device and of said severing device.

24. The apparatus of claim 22 wherein the first stage of the roll forming machine creates a raised center portion to the strip bounded by symmetrically spaced depressions bounded along two outer edges of the strip by edge portions generally co-planar with the raised center portion and wherein subsequent roll stages bend the strip upward around a centerline of the raised centerportion to form a closed muntin bar tube having a seam extending along its length.

25. The apparatus of claim 17, further comprising a conveyor for conveying the individual muntin bars away from the cutting station.

26. A tubular muntin bar comprising:

a) an elongated tube having either mitred or flat ends wherein the mitred ends include muntin bar portions that fit over mid portions of other muntin bars to form a part of a grid and where the flat ends form outer bounds of a completed muntin bar grid for contacting a window spacer frame;

5 b) said tube include side walls that have two relatively narrow top and bottom planar segments and two relatively wider side planar segments wherein the tube also includes a nonplanar transition portion between each side planar segment and either a top or a bottom planar segments and wherein one of the planar segments is formed by sheet portions of the tube that are bent to abut each other along a seam.

27. The apparatus of claim 26 comprising multiple muntin bars to form a grid and wherein the seams along the planar segments are not welded.

28. The apparatus of claim 26 wherein the top or the bottom planar segment of the muntin bar is formed by inwardly bending a lip portion of an elongated sheet of muntin bar material to form the elongated tube and wherein the sheet is bent in stages and wherein an early bending stage or stages forms two lips on the edges of said sheet and a later bending stage completes the formation of the top or the bottom generally planar surface of the elongated tube by bending two lips toward each other to form a seam and wherein intermediate bending stages after the early stages but before the latter stages leave the lips untouched.

29. The apparatus of claim 28 wherein the last and next to last stages contact the two lips to bend said lips together and form a seam along the elongated tube.